

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re application of:) Examiner: Gambetta, Kelly M.
Brent J. Bollman et al.)
Application Serial No. 10/719,040)
Filed: November 21, 2003) Art Unit: 1792
For: **Solvent Vapor Annealing of Organic**)
Films)

ON APPEAL TO THE BOARD OF PATENT APPEALS AND INTERFERENCES
APPELLANTS' BRIEF

MAIL STOP APPEAL BRIEF - PATENTS

Commissioner for Patents
P.O. Box 1450
Alexandria, Virginia 32613-1450

Dear Sir:

This Appeal Brief, filed in connection with the above captioned patent application, is responsive to the Final Office Action mailed on June 5, 2009. A Notice of Appeal was filed on November 5, 2009. Appellants request a four (4) month extension of time to extend the response deadline to May 5, 2010.

Appellants hereby appeal to the Board of Patent Appeals and Interferences from the final rejection in this case.

The following constitutes the Appellants' Brief on Appeal.

I. REAL PARTY IN INTEREST

The real party in interest is Nanosolar, Inc., by an assignment of the present application, U.S. Patent Application Serial No. 10/719,040 recorded, at Reel 014742 and Frame 0723.

II. RELATED APPEALS AND INTERFERENCES

There are no other prior and pending appeals, interferences or judicial proceedings known to appellants, the appellants' legal representative, or assignee which may be related to, directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

III. STATUS OF CLAIMS

Claims 1-16, 18, 20-22, and 24-27 are in this application.

Claims 1-16, 18, and 25-27 stand rejected and Appellants appeal the rejection of these claims.

Claims 20-22 and 24 are allowed.

IV. STATUS OF AMENDMENTS

A summary of the prosecution history for this case is as follows:

Previously, in response to the Office Action mailed on February 22, 2007, a Response to the Office Action was filed May 22, 2007. This was followed by a Final Office action mailed June 11, 2007, wherein a Response to the Final Office Action was filed by Appellants on August 14, 2007. An Advisory Action was mailed by the Office on August 20, 2007. An Examiner Interview was conducted on October 17, 2007. Finality of the previous Final Office Action was withdrawn and another Office Action was mailed on October 31, 2007. A Response to the Office Action was filed April 30, 2008. This was followed by a Final Office action mailed July 7, 2008, wherein a Response to the Final Office Action was filed by Appellants on September 5, 2008. An Advisory Action was mailed by the Office on September 18, 2008, wherein a Request for Continued Examination (RCE) was filed along with a Response to the Advisory Action. This was followed by an Office action mailed November 7, 2008, wherein a Response to the Office Action was filed by Appellants on March 9, 2009. A Final Office Action was mailed by the Office on June 5, 2009. A Notice of Appeal was filed on November 5, 2009 in this case.

A copy of the claims in the present Appeal is provided in the Claims Appendix.

V. SUMMARY OF CLAIMED SUBJECT MATTER

Methods for annealing an organic film are claimed. The method is characterized by exposing the organic film to a vapor of a solvent for a period of time sufficient to render at least an outermost portion of the organic film insoluble in the solvent, wherein without exposure to the vapor of the solvent, the organic film is dissolvable by the solvent. It is counterintuitive to expect that exposing an organic material to a vapor of a solvent would render that organic material insoluble to that same solvent.

The elements of independent claim 1 may be found in Figure 1 and in the specification at page 2, lines 22-27 (exposing organic film to solvent vapor to provide insolubility), page 4, lines 7-16 (evaporating the solvent and then exposing the film to solvent vapor; non-obviousness of creating insolubility from a vapor of a solvent that would dissolve the organic material), and page 1, lines 26-27 (support for disclaimer language).

The elements of independent claim 10 may be found in Figure 1 and in the specification at page 2, lines 22-27 (forming the solution and exposing organic film to solvent vapor to provide insolubility), page 4, lines 7-16 (evaporating the solvent and then exposing the film to solvent vapor), page 1, lines 26-27 (support for disclaimer language), and original claim 15 (wherein the first and second solvents are the same).

VI. GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

1. Whether Claims 1-16, 18, and 25-27 are obvious under 35 U.S.C. 103 over U.S. Patent No. 4,293,596 to Furendal et al. (hereinafter Furendal).

VII. ARGUMENTS

Summary of the Arguments:

The summaries of arguments are all discussed in greater detail, under their appropriate headings.

- a) The Office has not given sufficient consideration to all claim terms present in the claims of the presently claimed invention which clearly distinguish over Furendal.
- b) The Office has continued to incorrectly apply the teachings of the Furendal reference in its rejection of the currently pending claims. The Furendal reference is used in all of the Office's rejections, has been used in every Office Action in the prosecution history of the present application, has been discussed in all responses from the Appellant, and the proper interpretation of the teachings in Furendal is relevant to all Issues below.

Response to Rejections

ISSUE 1. Rejection under 35 U.S.C. 103(a) over Furendal:

Claims 1-16, 18, and 25-27 claim an invention that is not obvious in view of the teachings in Furendal

Independent claim 1 recites that insolubility of the outermost portion results ONLY from exposure of the organic film to the vapor of the solvent, wherein without exposure to the vapor of the solvent, the organic film is dissolvable by that SAME solvent. This feature is not shown or suggested by Furendal. As stated in the present application at page 4, lines 7-16, it is counterintuitive to expect that exposing an organic material to a vapor of a solvent would render that organic material insoluble to that same solvent.

New Argument: The Office has not given sufficient consideration to the term “ONLY” in Claim 1

As an initial matter, it seems that the Office's latest action has not given weight to all claim terms in the pending claims. By way of non-limiting example on page 2 first paragraph of the Final Office Action of June 5, 2009, the Office states at lines 9-10 that claim 1 as written does not exclude using a catalyst or heat treatment (to provide solvent resistance). Clearly, the Office has excluded the language at lines 3-4 of Claim 1 stating that “insolubility of the outermost portion results only from exposure of the organic film to the vapor of the solvent”. Any reasonable interpretation of the term ONLY as used in claim 1 would render moot the Office's statement at page 2, lines 9-10 of the Final Office Action of June 5, 2009, that claim 1 as written does not exclude using a catalyst or heat treatment.

Furthermore, it appears that the Office's comments on page 2 are directed to language that is not in claim 1 as written. For example, page 2 lines 10-12 of the Final Office Action of June 5, 2009 discusses that insolubility resulting directly from exposure to vapor does not exclude catalytic activity or heat treatment. Applicant notes, that the term "directly" is not used in claim 1 as written and that the Office appears to be referencing the wrong set of claims, not the currently pending claims.

The crux of the Office's Response to Arguments on page 2, first paragraph of the Final Office Action of June 5, 2009, is that claim 1 as written does not exclude other features such as catalytic activity or heat treatment. This illustrates, however, that the Office's interpretation of claims has not considered the claim term "only" in claim 1, as that term would render moot the Office's statements on page 2 of the Final Office Action of June 5, 2009.

The Office has taken positions unsupported by documentary evidence

The official notice taken by the Office relates to the statement in the last two Office Actions that "picking the same two solvents to serve both functions simplifies the process and prevents cross-contamination and would be the product of ordinary skill in the art and common sense (first paragraph page 3 of the Final Office Action of June 5, 2009; first paragraph page 6 paragraph of the Office Action of November 7, 2008).

Per MPEP 2144.03, if Applicant challenges a factual assertion as not properly officially noticed or not properly based upon common knowledge, the Examiner must support the finding with adequate evidence. In Appellant's response of March 9, 2009, Appellant has cited the present application stating that it is counterintuitive to expect that exposing an organic material to a vapor of a solvent would render that organic material insoluble in that solvent (see page 4, lines 7-8). Applicant notes that inventors herein are based on their experiences as persons of skill in the art, with inventor Matthew Robinson having a doctorate in chemistry from the University of California Santa Barbara and Brent Bollman with an engineering degree from Princeton University.

There has been no documentary evidence provided by the Office that it is common sense to find a solvent that can be both a solvent that dissolves a material and one who has vapors that can render that same material insoluble. Applicant has pointed out that the noticed fact stated

above is not considered by those skilled in the art to be common knowledge or well-known in the art to find a solvent that can perform both actions as presently claimed.

Per MPEP 2144.03, official notice unsupported by documentary evidence should only be taken by the examiner where the facts asserted to be well-known, or to be common knowledge in the art are capable of instant and unquestionable demonstration as being well-known. This directly contradicts text in the present application regarding basic intuition on chemical reactions.

New Argument: The Office has not shown a reasonable expectation of success

Per MPEP 2143.02, a reasonable expectation of success is required to establish a prima facie case of obviousness. A rationale to support a conclusion that a claim would have been obvious is that all the claimed elements were known in the prior art and one skilled in the art could have combined the elements as claimed by known methods with no change in their respective functions, and the combination would have yielded nothing more than predictable results to one of ordinary skill in the art.

For substantially the same reasons as set forth above, there is no expectation of success as it is counterintuitive to expect that exposing an organic material to a vapor of a solvent would render that organic material insoluble in that solvent. This directly contradicts text in the present application regarding basic intuition on chemical reactions.

The Office has set forth (first paragraph page 3 of the Final Office Action of June 5, 2009; first paragraph page 6 paragraph of the Office Action of November 7, 2008) that there is only a finite set of solvents in the boiling points set forth by Furendal. *Arguendo*, even if this were true, the number of solvents fitting this criteria can be enormous. More critically, however, the Office has provided no basis that there is any reasonable expectation that any of those solvents in the range set forth by Furendal will behave in the manner as currently claimed. It is counterintuitive to expect that exposing an organic material to a vapor of a solvent would render that organic material insoluble in that solvent. As this is not a predictable result as required by MPEP 2143.02, there is no showing by the Office that there is any reasonable expectation that the set of solvents described by the Office will react as presently claimed.

New Argument: Proceeding Contrary to Accepted Wisdom is Evidence of Nonobviousness

Per MPEP 2145(x)(D)(3), proceeding contrary to accepted wisdom is evidence of nonobviousness. Appellants respectfully submit that the foregoing regarding the counterintuitive nature of the methods of claims 1 and 10 as claimed is proceeding contrary to accepted wisdom, and thus evidence of nonobviousness.

The Office has incorrectly applied the teachings of the Furendal

For both claims 1 and 10, the fundamental issue with the Furendal reference lies in the Office's continued inaccurate interpretation that solvent exposure alone in Furendal creates insolubility. Although they may be found in prior actions as well, some examples of the Office's position can be found on page 2, line 4 of the Final Office Action of June 5, 2009, the Office states that the solvent causes the cross-linking (unsupported statement) and on page 5, lines 4-6, stating that Furendal discloses a method wherein exposing the organic film to a vapor of a solvent for a period of time sufficient renders at least an outermost portion of the organic film insoluble in the solvent (unsupported statement).

Those interpretations by the Office, however, are not supported by the written text in Furendal.

In support of its interpretation, the Office has cited in the Final Office Action of June 5, 2009 that support can be found in: a) the abstract and b) column 8, lines 11-65 in Furendal as showing that solvent exposure creates insolubility. Closer reading of the cited text, however, reveals no such support.

a) The abstract of Furendal (provided below for ease of reference) provides no teaching that the solvent exposure creates crosslinking or insolubility (emphasis added).

A method of coating which involves applying to a surface a dispersion containing a main bonding agent and a temporary bonding agent. The main bonding agent is not film forming at room temperature.

Next the continuous phase of the dispersion is permitted to evaporate or is driven off, followed by precipitation of the main bonding agent and the temporary bonding agent to form a porous powder layer on the surface.

The temporary bonding agent bonds the main bonding agent to the surface. The porous layer is then exposed to a solvent which causes the particles of the bonding agents to flow together, and any excess solvent is removed.

In fact, not only is there no mention of solvent exposure creating crosslinking or insolubility, the last sentence of the abstract teaches that there is flow of particles upon solvent exposure. In Appellant's response of March 9, 2009, Appellant set forth that for the context of the Furendal (as a patent related to paints), the purpose of the Furendal solvent vapor exposure, is not to harden the film or create insolubility, but to create a continuous film. Specifically, Furendal's states "that the solvent can dissolve or swell the particles at the exposure temperature used so that the particles can flow together and form a continuous surface coating". See col. 11 lines 63-65. This is corroborated by the text in the abstract. Applicant submits that this makes sense for a reference from a paint based technology group to create a continuous coating.

b) Column 8, lines 11-65 in Furendal (provided below for ease of reference) provides no teaching that the solvent exposure creates crosslinking or insolubility (emphasis added).

In accordance with the foregoing, the functional monomers can be utilized in order to achieve cross-linking of the surface coating. Such cross-linking is often desirable in order to obtain solvent resistance, increase the heat resistance, and in general to improve the physical and mechanical properties required of the final product. Such cross-linking can be achieved by a reactive group reacting with another group of the same kind, for instance an epoxy group from e.g. glycidyl methacrylate. This reaction is favored by catalysts. However, the most common way of achieving cross-linking is by having a reactive group react with a reactive group of a different kind, for instance, a carboxyl group from methacrylic acid reacts with an epoxy group from glycidyl methacrylate:

##STR1##

In accordance with the foregoing, cross-linking gives improved solvent resistance. However, a condition for the invention is that the polymer will be dissolved, in order to obtain film formation. Thus, cross-linking must not take

place until after the treatment with solvent. If, for instance, methacrylic acid and glycidyl methacrylate are included in the same polymer particle, there is a risk for partial cross-linking. We have found that premature cross-linking can be avoided by making two dispersions, one of them, for instance, containing methacrylic acid, and the other glycidyl methacrylate as functional monomers. The polymers are not cross-linked individually. Nor does cross-linking arise if the dispersions are mixed, as the reactive groups will not come into contact with each other.

A mixture of these particle dispersions can thus be applied to a surface and dried, and be exposed to solvent to form a coherent coating when the reactive groups come into contact with each other. Through heat activation, cross-linking can be obtained, whereby resistance to solvent and other effects according to the foregoing are achieved. Also other types of functional groups can be utilized in this way.

It is also possible to allow a functional group to be included in the hard polymer particles and another type of functional group to be included in the temporary bonding agent or added as a separate component.

It is also possible to cross-link e.g. ring-operating reactive groups by allowing a catalyst to participate in the exposure to solvent.

Furendal insolubility is not a result from ONLY solvent exposure. It is fundamental to the prosecution history that the Office has continued to inaccurately interpret the use of the solvent in Furendal to be something more than it is. There is no objective statement in Furendal that the solvent creates any insolubility. Even in the text cited by the Office, there is no showing that the solvent does anything more than create a coherent coating. As seen from the cited text above, without heat or catalyst, only using solvent exposure in Furendal does nothing to render at least an outermost portion of the organic film insoluble in the solvent, as recited by Claim 1.

More specifically, Furendal states that it is the cross-linking that provides the solvent resistance (see col. 8 lines 13-14, 35-36) and that cross-linking must not take place until after the treatment with solvent. See col. 8, lines 38-39. The main thrust of Furendal is that they have

come with a way to avoid premature cross-linking by making two dispersions. A mixture of these particle dispersions can thus be applied to a surface and dried, and be exposed to solvent to form a coherent coating when the reactive groups come into contact with each other. See Col. 8, lines 42-58. So, the method of Furendal requires some step to combine the two dried dispersions and that is where they vapor exposure step comes into play. It combines the particles and allow them to flow. Through heat activation or catalytic action, cross-linking can be obtained, whereby resistance to solvent and other effects according to the foregoing are achieved. Furendal is silent as to whether any action will happen following only solvent exposure.

As set forth in Applicant's response of May 22, 2007, all examples provided by Furendal fail to show that the resulting film is insoluble in the same solvent that provided the vapor and formed without heat treatment. Specifically, Furendal does not show that its films are resistant to the same solvent that provides the vapor (Furendal is typically void of any testing of the resulting film). For the examples that do show testing and some resistance, those examples use heat treatment to provide that resistance. For instance, only Example 16 (heated to 120° for 30 minutes), Example 29 (heated to 120 ° for 3 hours), and Example 30 (heated to 120 ° for 3 hours) are vapor-based examples in Furendal where the resulting film was tested in solvent. All of these examples, however, had post-solvent exposure heat treatment to provide this type of resistance.

Accordingly, as the Office has failed to set forth a *prima facie* case of obviousness based on Furendal, Claim 1 and its dependent claims are allowable over the cited reference(s). Claim 10 and its dependent claims are allowable for substantially the same reasons.

CONCLUSION

For the reasons set forth above, the Appellants submit that all claims are allowable over the cited art and define an invention suitable for patent protection. The Appellants therefore respectfully request that the BPAI reconsider the application and allow the application to proceed to issuance.

Respectfully submitted,

/Hao Y. Tung/

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Date: May 5, 2010

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VIII. CLAIMS APPENDIX

Claims on Appeal

1. A method for annealing an organic film, comprising:
exposing the organic film to a vapor of a solvent for a period of time sufficient to render at least an outermost portion of the organic film insoluble in the solvent, wherein insolubility of the outermost portion results only from exposure of the organic film to the vapor of the solvent;
wherein without exposure to the vapor of the solvent, the organic film is dissolvable by the solvent.

2. The method of claim 1 wherein the organic film includes a small-molecule material, dye, pigment, pentacene or pentacene precursor, C₆₀ and/or derivatives thereof, PCBM or polymer.

3. The method of claim 2 wherein the organic film includes a polymer material.

4. The method of claim 3 wherein the polymer material is an insulating polymer.

5. The method of claim 4 wherein the insulating polymer is poly(ethylene terephthalate) (PET) and poly(ethylene 2,6-naphthalate).

6. The method of claim 3 wherein the polymer material is an electrically conducting or semiconducting polymer.

7. The method of claim 6 wherein the polymer material includes a material from the group of poly(phenylene) and derivatives thereof, poly(phenylene vinylene) and derivatives thereof (e.g., poly(2-methoxy-5-(2-ethyl-hexyloxy)-1,4-phenylene vinylene (MEH-PPV), poly(para-phenylene vinylene), (PPV)), PPV copolymers, poly(thiophene) and derivatives thereof (e.g., poly(3-octylthiophene-2,5,-diyl), regioregular, poly(3-octylthiophene-2,5,-diyl),

regiorandom, poly (3-hexylthiophene) (P3HT), poly(3-hexylthiophene-2,5-diyl), regioregular, poly(3-hexylthiophene-2,5-diyl), regiorandom), poly(thienylenevinylene) and derivatives thereof, and poly(isothianaphthene) and derivatives thereof, tetra-hydro-thiophene precursors and derivatives thereof, poly-phenylene-vinylene and derivatives organometallic polymers, polymers containing perylene units, poly(squaraines) and their derivatives, discotic liquid crystals polyfluorenes, polyfluorene copolymers, polyfluorene-based copolymers and blends, e.g. co-polymerized and/or blended with materials such as charge transporting (e.g. tri-phenyl-amines and derivatives) and/or light-absorbing compounds (e.g. fused thiophene rings and derivatives, generally hetero-atom ring compounds with or without substituents).

8. The method of claim 1 wherein the solvent is an organic solvent.

9. The method of claim 8 wherein the organic solvent is selected from the group of acetone, chloroform, benzene, cyclohexane, dichloromethane, ethanol, diethyl ether, ethyl acetate, hexane, methanol, toluene, xylene, mixtures of two or more of these, and derivatives of one or more of these.

10. A method for forming an organic film, comprising:
placing a solution containing an organic material and a first solvent on a substrate;
evaporating the first solvent from the solution leaving an organic film on the substrate;
annealing the organic film by exposing it to a vapor of a second solvent for a period of time sufficient to render at least an outermost portion of the organic film insoluble in the first solvent,

wherein without exposure to the vapor of the second solvent, the organic film is dissolvable by the first solvent;

wherein the first solvent and second solvent are the same solvent.,

11. The method of claim 10 wherein the organic material includes a pigment, small-molecule material, dye, pentacene or pentacene precursor, C₆₀ and/or derivatives thereof, PCBM or polymer.

12. The method of claim 11 wherein the organic material is an insulating polymer.
13. The method of claim 12 wherein the insulating polymer is poly(ethylene terephthalate) (PET) and poly(ethylene 2,6-naphthalate).
14. The method of claim 10 wherein the organic material is a conducting polymer from the group of poly(phenylene) and derivatives thereof, poly(phenylene vinylene) and derivatives thereof (e.g., poly(2-methoxy-5-(2-ethyl-hexyloxy)-1,4-phenylene vinylene (MEH-PPV), poly(para-phenylene vinylene), (PPV)), PPV copolymers, poly(thiophene) and derivatives thereof (e.g., poly(3-octylthiophene-2,5,-diyl), regioregular, poly(3-octylthiophene-2,5,-diyl), regiorandom, poly (3-hexylthiophene) (P3HT), poly(3-hexylthiophene-2,5-diyl), regioregular, poly(3-hexylthiophene-2,5-diyl), regiorandom), poly(thienylenevinylene) and derivatives thereof, and poly(isothianaphthene) and derivatives thereof, tetra-hydro-thiophene precursors and derivatives thereof, poly-phenylene-vinylene and derivatives organometallic polymers, polymers containing perylene units, poly(squaraines) and their derivatives, discotic liquid crystals polyfluorenes, polyfluorene copolymers, polyfluorene-based copolymers and blends, e.g. co-polymerized and/or blended with materials such as charge transporting (e.g. tri-phenyl-amines and derivatives) and/or light-absorbing compounds (e.g. fused thiophene rings and derivatives, generally hetero-atom ring compounds with or without substituents).
15. The method of claim 10 wherein the first or second solvent is an organic solvent.

16. The method of claim 15 wherein the first solvent is selected from the group of is selected from the group of acetone, chloroform, benzene, cyclohexane, dichloromethane, ethanol, diethyl ether, ethyl acetate, hexane, methanol, toluene, xylene, mixtures of two or more of these, and derivatives of one or more of these.

Claim 17 (Canceled)

18. The method of claim 15 wherein the first and second solvents are both chloroform (CHCl₃).

Claim 19 (Canceled)

20. A method for making a device, comprising:
placing a first solution containing a first organic material and a first solvent on a first substrate;

evaporating the first solvent from the first solution leaving a film of the first organic material on the substrate;

annealing the first film of the first organic material by exposing it to a vapor of a second solvent for a period of time sufficient to render at least an outermost portion of the film of the first organic material insoluble in the first or second solvent;

placing a second solution containing a second organic material and a second solvent on a second substrate;

disposing the first and second substrates in proximity to each other with the film of the first organic material and the second solution disposed between the first and second substrates;

wherein the first substrate is a nanostructured material having pores, channels, cavities, or tubes with diameters between about 1 nm and about 100 nm, with a pore density between about 10¹² pores per square meter and about 10¹⁶ pores per square meter.

21. The method of claim 20, further comprising pressing the first and second substrates together.

22. The method of claim 20 wherein annealing the film of the first organic material by exposing it to a vapor of a second solvent occurs after the first and second substrates have been pressed together.

Claim 23 (canceled).

24. The method of claim 20 wherein the first organic material infiltrates the pores, channels, cavities, or tubes in the nanostructured material.

25. The method of claim 1 wherein insolubility of the outermost portion results directly from exposure of the organic film to the vapor of the solvent without heat treating the organic film.

26. The method of claim 10 wherein insolubility of the outermost portion results directly from vapor annealing.

27. The method of claim 10 wherein insolubility of the outermost portion results directly from vapor annealing without heat treating the organic film.

IX. EVIDENCE APPENDIX

None - no additional evidence is being relied upon by appellant in the appeal.

X. RELATED PROCEEDINGS APPENDIX

None- no decision rendered by a Court or the Board in any related proceedings identified above.